CNGA3 gene

cyclic nucleotide gated channel alpha 3

Normal Function

The *CNGA3* gene provides instructions for making one part (the alpha subunit) of the cone photoreceptor cyclic nucleotide-gated (CNG) channel. These channels are found exclusively in light-detecting (photoreceptor) cells called cones, which are located in a specialized tissue at the back of the eye known as the retina. Cones provide vision in bright light (daylight vision), including color vision. Other photoreceptor cells, called rods, provide vision in low light (night vision).

CNG channels are openings in the cell membrane that transport positively charged atoms (cations) into cells. In cones, CNG channels remain open under dark conditions, allowing cations to flow in. When light enters the eye, it triggers the closure of these channels, stopping the inward flow of cations. This change in cation transport alters the cone's electrical charge, which ultimately generates a signal that is interpreted by the brain as vision. This process of translating light into an electrical signal is called phototransduction.

Health Conditions Related to Genetic Changes

achromatopsia

More than 100 mutations in the *CNGA3* gene have been found to cause the vision disorder achromatopsia. These mutations underlie about 25 percent of cases of complete achromatopsia, a form of the disorder characterized by a total lack of color vision and other vision problems that are present from early infancy. *CNGA3* gene mutations have also been identified in a few individuals with incomplete achromatopsia, a milder form of the disorder associated with limited color vision.

The *CNGA3* gene mutations that underlie complete achromatopsia affect the production or function of the alpha subunit. In some cases, no protein is produced. In others, the protein is altered and does not function normally. CNG channels assembled without the alpha subunit or with an abnormal subunit are nonfunctional; they prevent cones from carrying out phototransduction. Researchers speculate that some defective channels allow a huge influx of cations into cones, which ultimately causes these cells to self-destruct (undergo apoptosis). A loss of cone function underlies the lack of color vision and other vision problems in people with complete achromatopsia.

A few mutations in the *CNGA3* gene reduce but do not eliminate the function of CNG channels in cones. These mutations cause incomplete achromatopsia because the partially functioning cones can transmit some visual information to the brain.

Because these CNG channels are specific to cones, rods are generally unaffected by this disorder.

cone-rod dystrophy

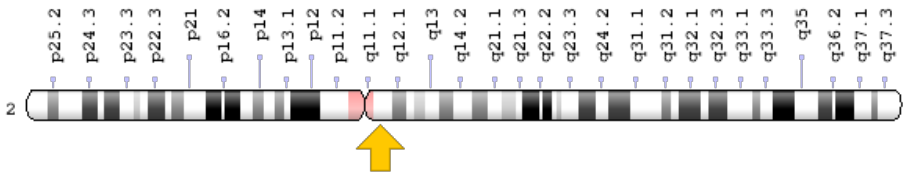
other disorders

Mutations in the *CNGA3* gene have also been identified in a small percentage of cases of progressive cone dystrophy. Like achromatopsia (described above), this condition affects the function of cones in the retina. However, unlike achromatopsia, progressive cone dystrophy is associated with cones that work normally at birth but begin to malfunction in childhood or adolescence. Over time, people with progressive cone dystrophy develop increasing blurriness and loss of color vision. It is unclear why some *CNGA3* gene mutations cause achromatopsia and others result in progressive cone dystrophy.

Chromosomal Location

Cytogenetic Location: 2q11.2, which is the long (q) arm of chromosome 2 at position 11.2

Molecular Location: base pairs 98,346,155 to 98,399,154 on chromosome 2 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- ACHM2
- CCNC1
- CCNCa
- CCNCalpha
- CNCG3

- CNG3
- CNGA3_HUMAN
- cone photoreceptor cGMP-gated channel alpha subunit

Additional Information & Resources

Educational Resources

- Neuroscience (second edition, 2001): Phototransduction
  https://www.ncbi.nlm.nih.gov/books/NBK10806/
- Webvision: The Organization of the Retina and Visual System (2010): Phototransduction in Rods and Cones
  https://www.ncbi.nlm.nih.gov/books/NBK52768/

GeneReviews

- Achromatopsia
  https://www.ncbi.nlm.nih.gov/books/NBK1418

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28CNGA3%5BTIAB%5D%29+OR+%28cyclic+nucleotide+gated+channel+alpha+3%5BTIAB%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D

OMIM

- CYCLIC NUCLEOTIDE-GATED CHANNEL, ALPHA-3
  http://omim.org/entry/600053

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_CNGA3.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=CNGA3%5Bgene%5D
- HGNC Gene Family: Cyclic nucleotide gated channels
  http://www.genenames.org/cgi-bin/genefamilies/set/250
- HGNC Gene Symbol Report
  http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=2150

- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/1261
- UniProt
  http://www.uniprot.org/uniprot/Q16281

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